UNIVERSITI TEKNOLOGI MARA

ENERGY EFFICIENCY IMPROVEMENT OF AN UNBALANCED ELECTRICAL DISTRIBUTION SYSTEM BASED ON THE CONSERVATIVE VOLTAGE REDUCTION IN TANDEM WITH THE OPTIMAL CAPACITORS PLACEMENT AND SIZING

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ABSTRACT

Energy efficiency can be achieved by means of minimizing the power losses with an adequate amount of energy utilized in an electrical distribution system. In this thesis, a detail analysis of energy efficiency of an electrical distribution system has been performed with an implementation of the conservative voltage reduction (CVR), and the optimal capacitor placement and sizing (OCPS). The differential evolution particle swarm optimization (DEPSO) is used to determine optimal location and sizing for the capacitors which in turn will improve the energy efficiency via energy consumption and power losses minimization. The pre-selection of busbar or locations is performed either based on the power-loss-index (PLI), randomly pre-selected location (RPL), or fixed pre-selected location (FPL). The DEPSO is designed based on the amalgamation of particle swarm optimization (PSO) and differential evolution (DE) that serves as a new mutation technique responsible to provide a new population with improved sizing and location of capacitors. The total cost of power losses, energy consumption and capacitor installation are the components considered in the objective and fitness functions of the proposed optimization technique. Voltage magnitude limit, total harmonic distortion (*THD*) limit, power factor limit and capacitor size limit are the parameters considered as the constraints for the proposed of optimization technique. Further improvement of energy efficiency is attained through CVR perpetrated by changing the transformer tap setting to reduce and then retain the voltage magnitude at a certain level whilst ensuring stability of the electrical distribution system. In this study, the proposed technique of DEPSO developed in MATLAB® will hand over the solution of capacitor locations, size as well as transformer tap position to the SIMULINK® software. Later, the SIMULINK® software will perform the load flow solution and pass the results to MATLAB® software to be analyzed. Effectiveness of the proposed methods used to improve the energy efficiency has been verified through several case studies and the results are obtained from the test systems of IEEE 13-bus unbalanced electrical distribution system and also the pragmatic electrical distribution system of Sultan Salahuddin Abdul Aziz Shah (SSAAS) building in Shah Alam, Selangor.

TABLE OF CONTENTS

	Page
COMFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xii
LIST OF FIGURES	xvii
LIST OF NOMENCLATURE	xxiv
LIST OF SYMBOLS	xxvi
CHAPTER ONE: INTRODUCTION	1
1.1 Background and Significance of Research	1
1.2 Problem Statement	4
1.3 Research Objectives	6
1.4 Scope of Work	7
1.5 Significant of Study	9
1.6 Organization of Thesis	10
CHAPTER TWO: LITERATURE REVIEW	12
2.1 Introduction	12
2.2 Optimal Capacitor Placement and Sizing (OCPS) in Unbalanced Electrical Distribution System	13
2.3 Conservative Voltage Reduction (CVR)	16
2.3.1 Implications in Implementing CVR	17
2.3.2 Strategies in Implementing CVR	18
2.4 Volt/Var Optimization	18
2.5 Summary	20

CHAPTER THREE: METHODOLOGY 21

3.1 Introduction 21

3.2 Design of Three-Phase Unbalanced Electrical Power Distribution Model in Matlab® and Simulink® Softwares 22

3.2.1 Data Conversion of Cable Length 24

3.2.2 Phase Impedance Matric to Sequence Impedance Matric Conversion 25

3.2.3 Designing Electrical Component Models in SIMULINK® Software 31

3.2.3.1 Busbar model embedded with the voltage and current (V/I) measurement tools 31

3.2.3.2 Distribution line or cable impedance 32

3.2.3.3 Three-phase load model embedded with the voltage and current (V/I) measurement tools 33

3.2.3.4 Single-phase harmonic injection model 34

3.2.3.5 Individual electrical equipment and component 35

3.2.4 Harmonic Data Conversion 35

3.2.5 Measurement and Extraction of Electrical Parameters from SIMULINK® Model 37

3.2.5.1 Total harmonic distortion (*THD*) measurement using goertzel algorithm toolbox 38

3.2.5.2 Total Power Losses Calculation 41

3.3 Designed of Electrical Distribution System of Sultan Salahuddin Abdul Aziz Shah (SSAAS) Building 42

3.3.1 Preparation of Data for The Unbalanced Electricity Distribution System in The Building of the Sultan Salahuddin Abdul Aziz Shah (SSAAS) 43

3.3.1.1 Riser cable impedances 45

3.3.1.2 Real and reactive power load selection 46

3.3.1.3 Harmonic data 48

3.4 Pre-Selection Techniques of Capacitors Placement 50

3.4.1 Methodology of Pre-Selected Locations for Capacitor Based Power Loss Index (PLI) 51

3.4.2 Methodology of Randomly Pre-Selected Locations for Capacitor (RPL) 54
3.4.3 Methodology of Fixed Pre-Selected Locations for Capacitor (FPL) 56
3.5 Conservative Voltage Reduction (CVR) Technique 59
3.5.1 Important Actions and Precautions to be Considered Before The Implementation of CVR to An Electrical Distribution System 62
3.6 Particles Swarm Optimization (PSO) Technique for The Optimal Capacitor Placements and Sizing 64
3.7 Amalgamation of Differential Evolution Approach with Particle Swarm Optimization (DEPSO) Technique for Optimal Capacitor Placements and Sizing 83
3.8 Pragmatic Implementation Of Conservative Voltage Reduction 88
3.8.1 Design, Schematic Diagram and Operation of the Capacitor Unit Installed in Unbalanced Electrical Distribution System of SSAAS Building 98
3.8.2 Switching of the Discrete Capacitors Size 98
3.8.3 Physical Design of Capacitor Bank Compartment 99
3.8.4 Diagram and the Operation of the Switched Capacitor Bank 101
3.9 Summary 102

CHAPTER FOUR: RESULTS AND DISCUSSION 105
4.1 Introduction 105
4.2 Description of The Test Systems 107
4.2.1 Configuration of IEEE 13-Bus Unbalanced Electrical Distribution System 107
4.2.1.1 Results for the IEEE 13-Bus Unbalanced Distribution System During Base Case Unbalanced Load Flow Solution 111
4.2.2 Unbalanced Electrical Distribution System of Sultan Salahuddin Abdul Aziz building (SSAAS) Building 113